REMARKS

Claims 1, 2, 4-12, 14-17, 19 and 21-30 are pending. Claims 22, 27 and 28 are amended herein. New claims 31-33 have been added herein. Support for the amendments is detailed below. Support for the new claims is found at page 4, line 10 to page 6, line 8 and Figs. 1A-1C of the specification.

Applicants' Response to the Claim Rejections under 35 U.S.C. § 112

Claim 22 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In response to the rejection applicants have herein amended claim 22 to depend from claim 5 which recites the antireflection film and removed the phrase "the size of."

In regard to the overall claim not reciting a size or how the films are reduced, applicants respectfully note that the language of the claim is clearly and distinctly supported by the disclosure in the specification. Particularly, page 5, line 10 to page 6, line 2 and Figs 1B-1C teach that the original level of resist pattern 6 and antireflection film 5 are reduced in size. Figs 1B and 1C illustrate the original level of the photoresist as a dash box 6 and the reduced pattern as 6a. The specification and claims explain that the films are reduced as a result of their exposure during the etching process. Further, the specification provides the example of the width being reduced from 80nm to 45nm. See page 5, lines 23-25. As such, applicants respectfully submit that the claim is distinct when amended to correct antecedent basis and dependency.

Applicants' Response to the Claim Rejections under 35 U.S.C. § 103(a)

The Office has maintained the rejection of claims 1, 2, 4-6, 9-12, 14, 17, 19, 21 and 22 under 35 U.S.C. § 103(a) as being unpatentable over Cho et al. (US 6,579,808) in view of Lou et al. (US 6,110,826). Applicants respectfully traverse. Specifically, one of skill in the art would not look to an etch recipe for etching an interlayer dielectric as in Lou as an obvious replacement for etching a photoresist, as in Cho, for forming a narrower aperture in a photoresist.

In regard to motivation to combine, the Office Action states that "Cho teaches the use of an oxygen containing gas such as SO_2 along with an inert gas as an etch gas mixture" and that Lou teaches the photoresist pattern on the IMD layer is exposed to an etch plasma preferably comprising SO_2, O_2, and He at col. 6, lines 1-15. The Office asserts that this means that Lou teaches that the PR pattern is subjected to etch on the sidewalls and surfaces during the exposure to the etch gas. Further, the Office Action states that in Lou the claimed etch gas mixture removes the underlying etch-stop layer (SiN layer 250) from the bottom trench along with the transfer of the pattern of the resist layer to the IMD layer.

As such, the Office asserts that the motivation to use the etch gas of Lou in the process of Cho is to remove an underlying etch stop while patterning a groove. However, there is no such etch stop layer in Cho, nor would the process of Cho entail etching an etch stop layer of SiN. As previously noted, Cho is directly teaching that sidewalls of polymer 210, generated during the etch process of the photoresist 208 and the anti-reflective coating 207, are built up along the sides of the bottom of the trench formed. As a result, the original aperture a2 is reduced in size b2.

See Fig. 3B. Therefore, when the underlying insulator 205 is etched, by a completely different etch gas 222, the etch aperture b2 is narrower than the photoresist aperture 208. See Figs. 3C-3D.

In response to applicants' argument that Lou and Cho are directed to the etching of different materials, the Office asserts that Lou teaches that a photoresist is formed over the etched IMD. In doing so, the Office appears to assert that it is inherent that the photoresist would be etched by the gas used to form the grooves in the IMD film. See page 9, section 10, C) of the Office Action. However, applicants respectfully submit that there is no basis for this assertion. One of skill in the art would readily understand that the photoresist of Lou is patterned prior to the etching step described. Col. 5, line 65 to col. 6, line 1. Lou states that the line trench 325 in the IMD layer "is formed by etching the line trench pattern in the first photoresist layer into IMD layer (300)." Col. 6, lines 2-3. There is no teaching or suggestion that the photoresist is etched during this step.

Lou teaches that the photoresist has already been patterned and that only the interlevel dielectric layer 300 is etched by an etch gas of O_2, He, SO_2 and CF_4. A second gas of the same components but different flow rates etches the underlying etch stop layer 250. In Lou's invention, as shown in Fig. 3a, the line trench 325 is formed by etching the IMD layer 300 using photoresist (not shown) as an etching mask. See col. 5, line 65 to col. 6, line 1. Gases O_2, SO_2, CF_4 and He are used. It is a common knowledge for a person having ordinary skill in the art that the IMD layer 300 is etched under the condition where the photoresist is not side-etched.

Specifically, whether the photoresist is side-etched depends upon process conditions, e.g., bias power, pressure, gases and similar. Namely, Lou discloses etching gas comprises SO_2, He and O_2 but does not disclose a step of etching a surface layer of sidewalls of photoresist.

In response to applicants' argument that Chu teaches away from the use of O_2 gas in the etch recipe, the Office disagrees. The Office Action asserts that Cho "merely discloses the reactivity rate comparison of SO_2 to that of O_2 gas." See page 9, section 10, D) of the Office Action. However, the clear reason to one of skill in the art that Cho mentions the high reactivity of O_2 in comparison to SO_2 is because the reactivity rate of O_2 will interfere with the formation of the polymer sidewalls in Chu. This is supported by the disclosure in the Kanegae reference cited by the Office against claims 27-30. Specifically, as noted in paragraph [0168] of Kanegae discussing etch gas recipes: "O_2 gas is often added for the purpose of removing a polymer film." As such, since Chu requires a polymer 210 build up in the base of the trench in the photoresist 208 and antireflection film 207, one of skill in the art would readily discern that the mention of the high reactivity rate of O_2 in Chu is a teaching away from its inclusion in the gas.

Wherefore, there is no basis whereby one of skill in the art would be motivated to substitute the etch gas of Cho with that of Lou to derive the currently claimed invention. Cho does not teach an underlying etch stopper for etching. Further, the recipe of the etch gas of Cho is specifically designed to form polymer sidewall structures at the base of the aperture which is contrary to the teachings of Lou and the use of O_2 gas.

Claims 7, 8, 15 and 16 are rejected under 35 U.S.C. §103(a) as being unpatentable over Cho et al. in view of Lou et al. and further in view of Ohkuni et al. (US 6,187,688). Claims 23-26 are rejected under 35 U.S.C. §103(a) as being unpatentable over Cho et al. in view of Lou et al, and further In view of Tsai et al. (US 2003/0134231). The rejection to these claims should likewise be considered addressed based on their dependency to the parent claims addressed above. Further, applicants note that the Office maintains Tsai, in [0007], discloses that SO_2/O_2 mixture gas is used to reduce the resist pattern width. However, Tsai disclose that SO_2 based chemistry is used to reduce **the micro-loading effects**. Tsai does not disclose reducing the resist pattern width.

Claims 27-30 are rejected under 35 U.S.C. §103(a) as being unpatentable over Cho et al. in view of Kanegae et al. (US 2002/0061654). Applicants have herein amended claims 27 and 28 to more distinctly claim the subject matter regarded as the invention. Specifically, applicants have included the feature that the mixture gas does not contain halogen based gas. See page 9 of the specification. Cho discloses the etching gas of SO_2 and He. Kanegae discloses that a rare gas such as Ar, Kr, Xe, Ne etc., is mixed with the main etching gas, which is a CF gas (halogen-based gas). See paragraph [0168]. In contrast, neither the main etching gas of Cho nor the present invention contains CF gas. Neither Cho nor Kanegae disclose that a rare gas such as Ar, Kr, Xe, Ne etc., is mixed with the main etching gas that is not halogen-based gas. As such, applicants respectfully submit that there is no basis whereby one of skill in the art would

combine the rare gases of Kanegae with the gases of Cho to derive the currently claimed invention.

In view of the aforementioned amendments and accompanying remarks, Applicant submits that that the claims, as herein amended, are in condition for allowance. Applicant requests such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP

Michael J. Caridi
Attorney for Applicants
Registration No. 56,171
Telephone: (202) 822-1100
Facsimile: (202) 822-1111

MJC/ttw